

Development Requirements for Spacesuit Bearings

Functional Requirements for spacesuit bearings:

- 1) Provide the ability to rotate joints of a spacesuit during EVAs in vacuum, lunar, and Mars environments (dust) for 100 EVAs of operation without requiring maintenance with minimal leakage.

Preliminary Performance Requirements:

- 1) The system shall meet all performance requirements within the operating temperature range of: +41 °F- 115° F.
Rationale: This is the expected operating temperature range within the insulated area of the space suit system, including the pressurized volume within the expected operational cases.
- 2) The system shall meet all performance requirements within an operating pressure range of 0-10.6 psid relative to a surrounding vacuum environment.
Rationale: This is the expected operational pressure range for the space suit system.
- 3) The system shall be designed to withstand an internal pressure of 17.6 psid without structural failure.
Rationale: This is a proof test of the system to ensure a 2.0 factor of safety for most normal operating cases.
- 4) The system shall be capable of bearing a TBD lb. force load indefinitely down the long axis of the connecting axial brackets in addition to the operational pressure load on the system.
Rationale: This requirement simulates the “man-load” or what the wearer of the system can induce while wearing the space suit.
- 5) The system shall meet an ultimate design factor of safety of 2.0 with respect to all expected load cases on the system.
Rationale:
- 6) The bearings shall leak on average no more than 0.1 SCCM per inch of bearing circumference when pressurized to 8.3 psid above 14.7 psig.
Rationale: This requirement is an approximation based on the full suit assembly leakage requirement allotted down based on seal run length throughout the suit. Each inch of bearing length is not expected to be tested.

- 7) The system shall have a useful life of 624 hours of manned, pressurized usage time.
Rationale: The usage life assumes 100 EVAs plus checkout and certification testing.
- 8) Each bearing shall not exceed a bearing breakaway (starting) torque greater than 1 in-lb per inch of bearing race run length at 8.3 psid.
Rationale: This requirement is an approximation based on historical bearing breakaway torque data.
- 9) The system materials shall be compatible with a 100% oxygen environment in the operational pressure ranges.
Rationale: This requirement includes both material compatibility as well as flammability and ignitability concerns.
- 10) The system shall be designed such that subcomponents of the system are interchangeable with other components of the same design.
- 11) The system shall be designed such that the system can be serviced and repaired with common tools.

Design Considerations

- 1) Bearing mass must be minimized to the extent possible. Optimization of geometry and material choice should be investigated to reduce mass while meeting safety and cycle life based requirements.